Temperature constraint in Upland rice improvement in the High Plateau of Madagascar

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In Madagascar, rice is cultivated on 1.3Mha of which 29% are upland rice, growing from the coastal area up to the higher altitude. In the mid-1980s, CIRAD and FOFIFA launched a research program for the highlands with the aim of pushing forward the frontier of upland rice growing areas in high elevation areas. Today, upland rice is a part of the Madagascar Highland?s landscape and creates new breeding challenges. Low temperatures slow down rice growth at almost all stages: panicle initiation is delayed and cold conditions during the reproductive stage may induce high sterility rate. Thermal environment also is known to affect the speed of vegetative development of the crop, thus the crop duration itself. Climate change is assumed to result in a rise of mean Temperatures of 2-5 degrees depending on the simulation scenario. Thus rice cropping in higher altitudes may become more favorable as long as precipitation is not a limiting factor. Fields experiments were conducted in three locations along an altitudinal gradient, by using ten contrasting upland genotypes with 5 monthly staggered planting dates. Physiological and Phenological responses, grain yield and yield components, harvest index and sterility were observed in view of detecting genotypic differences across changing environments. In all ten varieties, crop duration was longer in higher altitude as compared to lower altitude while Harvest index was found to be higher in lower altitude. Low temperature effect was revealed by the rate of sterility. The percentage of filled spikelet was linked to the minimal Temperature between booting and heading stage and a linear relationship was used to detect the threshold Temperature leading to sterility for all varieties studied. Cold tolerant varieties adapted to high altitude showed higher yield in high altitude when sown in the recommended sowing date and performed well in both favorable and unfavorable environment. These varieties can respond favorably in high altitude upland rice cropping with changing climate and used as upland rice ideotype. Adaptability to low temperature was studied and results can be used for modeling to foresee climatic change scenarios.

Keywords: upland rice, high altitude, breeding, climate change, adaptation

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